PATENT ABSTRACTS OF JAPAN

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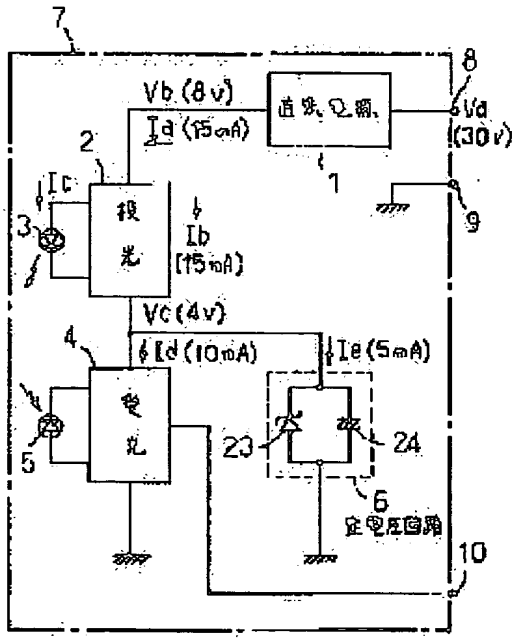
(54) PHOTOELECTRIC SWITCH

(57)Abstract:
PURPOSE: To increase the projection current of a compact and lightweight photoelectric switch and to extend a set distance up to a detected article.
CONSTITUTION: A projecting circuit 2 and a light receiving circuit 4 are serially connected to a DC power supply circuit 1. A current Ia of constant voltage Vb is supplied from the circuit 1 to the circuit 2 to emit a projecting element 3, so that the projecting current Ic of the element 3 is increased and the intensity of light emission is increased. In order to stabilize the input voltage of the circuit 4, a constant voltage circuit 6 is connected to the circuit 4 in parallel. A current from the circuit 2 is allowed to dividedly flow into respective circuits 4, 6. Consequently the increment of the projection current and the extension of a set distance can be attained without increasing the power consumption of the circuit 1 capable of most easily generating heat while holding the compact and lightweight property of the photoelectric switch.



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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] A photoelectric switch characterized by carrying out series connection of a floodlighting circuit which makes a floodlighting element emit light with current from this DC-power-supply circuit in a DC-power-supply circuit which supplies power of a constant voltage, and the light-receiving circuit equipped with a photo detector which receives light from a floodlighting element of a floodlighting circuit.
[Claim 2] A photoelectric switch characterized by carrying out parallel connection of the voltage stabilization circuit which stabilizes input voltage of this light-receiving circuit in a light-receiving circuit according to claim 1.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the small lightweight photoelectric switch which made the DC-power-supply circuit, the floodlighting circuit, and the light-receiving circuit build in one housing.
[0002]
[Description of the Prior Art] The small lightweight reflective mold photoelectric switch used for goods existence detection of the distant location is making the main circuit of a DC-power-supply circuit (1'), a floodlighting circuit (2'), and a light-receiving circuit (4') build in one housing (7'), as shown in drawing 3 . A DC-power-supply circuit (1') lowers the pressure of the DC-power-supply voltage Va from an input terminal (8) to a constant voltage Vb, and supplies it to a floodlighting circuit (2') and a light-receiving circuit (4'). The parallel circuit of a floodlighting circuit (2') and a light-receiving circuit (4') is connected to a DC-power-supply circuit (1').
[0003] A floodlighting circuit (2') is equipped with the floodlighting element (3) of light emitting diode. A floodlighting circuit (2') consists of an oscillator circuit for making it synchronize with a light-receiving circuit (4'), and a drive circuit of a floodlighting element (3). The consumed electric current (average floodlighting circuit current) Im which flows in a floodlighting circuit (2') from a DC-power-supply circuit (1') is mostly decided by the floodlighting current Ih which flows for a floodlighting element (3). A light-receiving circuit (4') is equipped with the photo detector (5) which receives the light of a floodlighting element (3). A light-receiving circuit (4') consists of the amplifying circuit and oscillator circuit of the signal from a photo detector (5), a detector circuit, etc., judges the signal level of a photo detector (5), and outputs goods existence to an output terminal (10). Housing (7') is for example, a resin mold package, and is equipped with an input terminal (8), an output terminal (10), and a grounding terminal (9).
[0004] In order to make a photoelectric switch into a small light weight, as for each of a DC-power-supply circuit (1'), a floodlighting circuit (2'), and a light-receiving circuit (4'), few circuits of the components mark by which most was IC-ized are used. Moreover, in this photoelectric switch, since low pyrexia and low-power-ization are desired for a DC-power-supply circuit (1') etc., the consumed electric current of the whole photoelectric switch is restricted to about 15mA.
[0005] compared with switching power supply, the voltage stabilizer of the dropper type (series power supply) with which there are few components mark and they end uses a DC-power-supply circuit (1') for a miniaturization -- having -- about 30 [for example,] -- the pressure of the DC-power-supply voltage Va which is V is lowered to the rated voltage Vb of a floodlighting circuit (2') and a light-receiving circuit (4'), for example, the constant voltage of 8V.
[0006] The 10mA consumed electric current In flows in the light-receiving circuit (4') where the constant voltage Vb of 8V is impressed, and cutting down this consumed electric current In that is 10mA is not made on circuitry in it. Moreover, in the floodlighting circuit (2') where the constant voltage Vb of 8V is impressed, the 5mA consumed electric current Im flows. The peak value of the floodlighting current Ih which flows for the floodlighting element in this case (3) is about 100mA as 5% of duty ratios, and a floodlighting element (3) emits light by the reinforcement proportional to this floodlighting current Ih. The 15mA current Ia which is the consumed electric current of the whole photoelectric switch is made to shunt toward a floodlighting circuit (2') and a light-receiving circuit (4'), and a DC-power-supply circuit (1') supplies it.
[0007]
[Problem(s) to be Solved by the Invention] Although it is designed so that the setting distance between the goods which the small lightweight photoelectric switch of the above-mentioned structure enlarges floodlighting current Ih as much as possible, and can be detected may be extended, floodlighting current Ih has already reached the maximum in the reason for the after-mentioned, and increase-izing of setting distance is difficult for the present condition.
[0008] For example, for the DC-power-supply voltage Va, the consumed electric current Im of 30V and a floodlighting circuit (2') is [the consumed electric current In of 5mA and a light-receiving circuit (4') of the power consumption of the whole photoelectric switch of drawing 3] 30Vx(10+5) mA=450mW as 10mA. Among this, there is most power consumption of a DC-power-supply circuit (1') as V (30-8)x15mA = 330mW, and a DC-power-supply circuit (1') generates heat most in the amount according to this power consumption. If this pyrexia uses a drop power supply (series power supply) with few circuit elements for a DC-power-supply circuit

(1') at all for a miniaturization, it is an unavoidable place. Moreover, compact mounting of each of a DC-power-supply circuit (1'), a floodlighting circuit (2'), and a light-receiving circuit (4') is carried out by the density of the degree from which a circuit element does not receive damage by pyrexia of a DC-power-supply circuit (1'), and small lightweight-ization of a photoelectric switch is attained.
[0009] In this photoelectric switch, although it is possible in circuit, in proportion to an increased part of floodlighting current Ih, especially the calorific valu of a DC-power-supply circuit (1') increases, and the increase of the power consumption of a photoelectric switch and a possibility of increase [floodlighting current Ih] that circuit elements, such as IC, may be destroyed with heat increase. Although the problem of pyrexia by increase of floodlighting current Ih can make packaging density of each circuit small or can solve it by adding a thermolysis means, if it does in this way, a photoelectric switch will large-sized-ize, and the fault used as the cost high arises. moreover, the part which increased floodlighting current Ih and a DC-power-supply circuit (1') -- the big thing of a power supply -- being needed -- a photoelectric switch -- still more -- alike -- the cost high -- it large-sized-izes.
[0010] The place made into the purpose of this invention is to offer the photoelectric switch to which floodlighting current can increase while [small] it has been lightweight.
[0011]
[Means for Solving the Problem] Technical means of this invention which attains the above-mentioned purpose are having carried out series connection of a floodlighting circuit which makes a floodlighting element emit light with current from this DC-power-supply circuit in a DC-power-supply circuit which supplies power of a constant voltage, and the light-receiving circuit equipped with a photo detector which receives light from a floodlighting element of a floodlighting circuit.
[0012] In such a photoelectric switch, it is desirable to carry out parallel connection of the voltage stabilizer to a light-receiving circuit, after that a light-receiving circuit is [of operation] stable.
[0013]
[Function] If series connection of a floodlighting circuit and the light-receiving circuit is carried out to a DC-power-supply circuit, the voltage drop (power consumption) in the DC-power-supply circuit which is a drop power supply falls, a part for this power can be supplied to a floodlighting circuit, the floodlighting current of a floodlighting circuit increases, and the setting distance from a photoelectric switch to goods can be extended. Moreover, since the calorific value of a DC-power-supply circuit becomes small and the capacity is conventionally made as for it to eye small **, the small light weight of a photoelectric switch is maintainable.
[0014] Moreover, if parallel connection of the voltage stabilizer is carried out to the light-receiving circuit, the input voltage of a light-receiving circuit will become fixed, without being influenced of a floodlighting circuit, actuation of existing light-receiving circuits, such as an amplifying circuit, will be stabilized, and the property of a photoelectric switch will be stabilized.
[0015]
[Example] Hereafter, an example is explained with reference to drawing 1 and drawing 2 . The photoelectric switch shown in drawing 1 is a reflective mold photoelectric switch which built the DC-power-supply circuit (1), the floodlighting circuit (2), and the light-receiving circuit (4) in one housing (7), and is characterized by connecting a floodlighting circuit (2) and a light-receiving circuit (4) to a serial in a DC-power-supply circuit (1). A DC-power-supply circuit (1) passes the current Ia which lowered the pressure of the DC-power-supply voltage Va from an input terminal (8) to the constant voltage Vb in a floodlighting circuit (2) and a light-receiving circuit (4). The constant voltage Vc whose pressure was lowered in the floodlighting circuit (2) is impressed to a light-receiving circuit (4), and parallel connection of the voltage stabilizer (6) is carried out to a light-receiving circuit (4) in order to stabilize this constant voltage Vc uniformly.
[0016] Most is the circuit of the low power which carries out a low-battery low current drive and a low exoergic type with few IC-ized components mark, and that of each of the DC-power-supply circuit (1) of the photoelectric switch of drawing 1 , a floodlighting circuit (2), and a light-receiving circuit (4) is fundamentally the same as that of the thing of the photoelectric switch of drawing 3 , and the same sign is given to the intersection of drawing 1 and drawing 3 . The photoelectric switch of drawing 1 is explained that the photoelectric switch of drawing 1 is the same power consumption type as the photoelectric switch of drawing 3 .

[0017] A DC-power-supply circuit (1) lowers the pressure of an input terminal (8) Va, for example, the DC-power-supply voltage of 30V, to the constant voltage Vb of 8V, and supplies 15mA current Ia to a floodlighting circuit (2). It is a drop power circuit as shown in drawing 2 , and a DC-power-supply circuit (1) is equipped with the protection diode for antisuckbacks (11), the zener diode (12) which is a constant-voltage element, resistance (13), a smoothing capacitor (14), etc. The constant voltage Vb of 8V of a DC-power-supply circuit (1) is impressed to the series circuit of a floodlighting circuit (2) and a light-receiving circuit (4), and the direct current voltage of 4V which pressured partially the constant voltage Vb of 8V is impressed to each of a floodlighting circuit (2) and a light-receiving circuit (4). In this case, the circuit design of each of a floodlighting circuit (2) and a light-receiving circuit (4) is carried out so that it may operate by rated voltage 4V, and this point differs from the floodlighting circuit (2') of drawing 3 , and a light-receiving circuit (4').
[0018] The 15mA current Ia from a DC-power-supply circuit (1) flows as the consumed electric current Ib in a floodlighting circuit (2) as it is. A floodlighting circuit (2) consists of an oscillator circuit (15) and a drive circuit (16) of a light emitting device (3), as shown in drawing 2 . The 15mA consumed electric current Ib of a

floodlighting circuit (2) is 3 times the 5mA consumed electric current In of the floodlighting circuit (2') of the drawing 3 photoelectric switch. Therefore, the peak value of the floodlighting current Ic which flows for a floodlighting element (3) will be set to about 300mA as 5% of duty ratios, and will be about 3 times the floodlighting current Ih of the drawing 3 photoelectric switch. The setting distance to the goods with which the luminous intensity of a floodlighting element (3) can detect only the increment of this floodlighting current Ic by increase and the photoelectric switch is prolonged. actually -- the conventional ratio of floodlighting current Ic -- [0019] that setting distance increases 1.7 times by the conventional ratio turns out to be by the 3 times as many increment as this The voltage stabilizer (6) by which parallel connection was carried out to the light-receiving circuit (4) is a parallel circuit of zener diode (23) and a smoothing capacitor (24), and makes 4V stabilize the input voltage of a light-receiving circuit (4). To the parallel circuit of a light-receiving circuit (4) and a voltage stabilizer (6), 15mA current flows from a floodlighting circuit (2). If the consumed electric current Id of a light-receiving circuit (4) is set to the same 10mA as the light-receiving circuit (4') of drawing 3 , the 5mA consumed electric current Ie will flow to a voltage stabilizer (6).

[0020] A light-receiving circuit (4) is equipped with the oscillator circuit (19), detector circuit (20), and output circuit (21) for a comparator (18) and a synchronization which judge goods existence for the amplifying circuit (17) which amplifies the light-receiving signal of a photo detector (5), and the amplified signal as compared with reference level as shown in drawing 2 . Actuation of an amplifying circuit (17) etc. becomes unstable for the voltage Vc of 4V the pressure of was lowered in the floodlighting circuit (2) impressed to this light-receiving circuit (4) to be unstable, and the reliability of goods existence detection worsens. Then, in order to cancel this instability of operation, parallel connection of the voltage stabilizer (6) is carried out to a light-receiving circuit (4). Input voltage of a light-receiving circuit (4) is fixed-ized to 4V as a voltage stabilizer (6) is also at the zener voltage of 4V of zener diode (23), and actuation of a light-receiving circuit (4) is made stable.

[0021] The power consumption of the photoelectric switch of drawing 1 is 30Vx(10+5) mA=450mW, and is the same as that of the power consumption of the photoelectric switch of drawing 3 . That is, the drawing 1 photoelectric switch has the drawing 3 photoelectric switch and the same calorific value, and is mostly formed into small lightweight by the same size with the drawing 3 photoelectric switch.

[0022] If the current value passed in the floodlighting circuit (2) of the photoelectric switch of drawing 1 passes 10mA current in addition to 15mA, floodlighting current becomes twice [about] floodlighting current of the photoelectric switch of drawing 3 , and setting distance with goods is prolonged. In this case, 150mW of power consumption of the photoelectric switch of drawing 1 becomes less than 450mW of power consumption of the photoelectric switch of drawing 3 , the calorific value of the photoelectric switch of that part and drawing 1 decreases, and a miniaturization can be attained more.

[0023]

[Effect of the Invention] Since it flows in a floodlighting circuit as it is according to this invention, without shunting a direct current from a DC-power-supply circuit, increase-ization of the floodlighting current of a floodlighting circuit becomes easy, without making the power consumption of a DC-power-supply circuit increase, and the small lightweight photoelectric switch of the high performance in which extension-izing of the setting distance to goods is possible can be offered.

[0024] Moreover, the photoelectric switch of the high-reliability by which the input voltage of a light-receiving circuit became fixed, without being influenced of a floodlighting circuit, actuation of a light-receiving circuit was stabilized, and the operating characteristic was stabilized can be offered by carrying out parallel connection of the voltage stabilizer to the light-receiving circuit.

[Translation done.]

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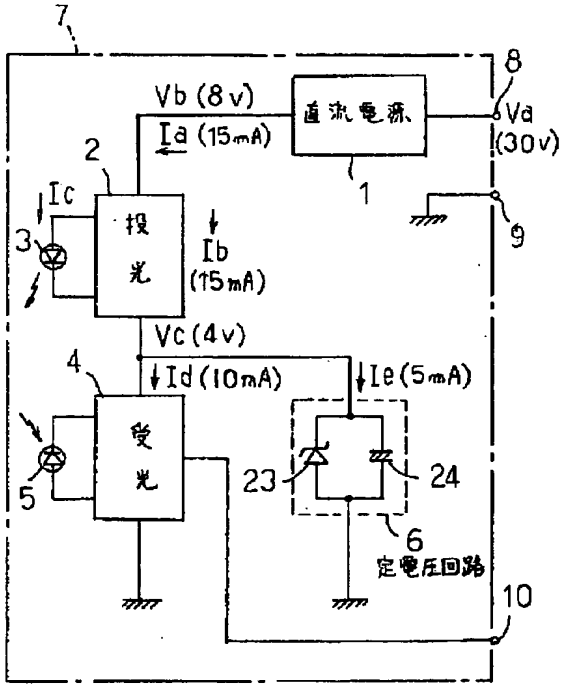
(54)【発明の名称】　光電スイッチ

(57)【要約】

【目的】　小形軽量光電スイッチの投光電流の増大化、検出物品までの設定距離の延長化。

【構成】　直流電源回路（1）に投光回路（2）と受光回路（4）を直列接続する。直流電源回路（1）から定電圧Ｖｂの電流Ｉａを投光回路（2）に供給し、投光素子（3）を発光させるようにすることで、投光素子（3）の投光電流Ｉｃが増大して、発光強度が増す。受光回路（4）の入力電圧を安定させるために、受光回路（4）に定電圧回路（6）を並列接続する。投光回路（2）から電流は、受光回路（4）と定電圧回路（6）に分流して流れる。最も発熱し易い直流電源回路（1）の消費電力を増大させず、光電スイッチの小形軽量化を可能にしたまま、投光電流の増大化、設定距離の延長化を可能にする。



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【特許請求の範囲】

【請求項１】　定電圧の電力を供給する直流電源回路に、この直流電源回路からの電流で投光素子を発光させる投光回路と、投光回路の投光素子からの光を受光する受光素子を備えた受光回路とを直列接続したことを特徴とする光電スイッチ。

【請求項２】　請求項１記載の受光回路に、この受光回路の入力電圧を安定させる電圧安定回路を並列接続したことを特徴とする光電スイッチ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、１つのハウジングに直流電源回路と投光回路、受光回路を内蔵させた小形軽量の光電スイッチに関する。

【０００２】

【従来の技術】離れた場所の物品有無検出に使用される小形軽量の反射型光電スイッチは、図３に示すように、直流電源回路（1'）と投光回路（2'）と受光回路（4'）の主回路を１つのハウジング（7'）に内蔵させている。直流電源回路（1'）は、入力端子（8）からの直流電源電圧Ｖａを定電圧Ｖｂに降圧して投光回路（2'）と受光回路（4'）に供給する。投光回路（2'）と受光回路（4'）の並列回路が直流電源回路（1'）に接続される。

【０００３】投光回路（2'）は、発光ダイオードの投光素子（3）を備える。投光回路（2'）は、受光回路（4'）と同期させるための発振回路や投光素子（3）のドライブ回路で構成される。直流電源回路（1'）から投光回路（2'）に流れる消費電流（平均投光回路電流）Ｉｍは、投光素子（3）に流れる投光電流Ｉｈでほぼ決まる。受光回路（4'）は、投光素子（3）の光を受光する受光素子（5）を備える。受光回路（4'）は、受光素子（5）からの信号の増幅回路や発振回路、検波回路などで構成され、受光素子（5）の信号レベルを判定して出力端子（10）に物品有無の出力をする。ハウジング（7'）は、例えば樹脂モールドパッケージで、入力端子（8）と出力端子（10）及びアース端子（9）を備える。

【０００４】光電スイッチを小形軽量にするため、直流電源回路（1'）と投光回路（2'）と受光回路（4'）のそれぞれは、大部分がＩＣ化された部品点数の少ない回路が使用される。また、かかる光電スイッチにおいては、直流電源回路（1'）などが低発熱・低消費電力化が望まれることから、光電スイッチ全体の消費電流が約１５ｍＡに制限されている。

【０００５】直流電源回路（1'）は、小型化のため、スイッチング電源に比べて部品点数が少なくて済むドロッパータイプ（シリーズ電源）の定電圧回路が使用され、例えば約３０Ｖの直流電源電圧Ｖａを投光回路（2'）と受光回路（4'）の定格電圧、例えば８Ｖの定電圧Ｖｂに降圧する。

【０００６】８Ｖの定電圧Ｖｂが印加される受光回路

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（4'）には１０ｍＡの消費電流Ｉｎが流れ、この１０ｍＡの消費電流Ｉｎを減らすことは回路構成上できない。また、８Ｖの定電圧Ｖｂが印加される投光回路（2'）には、５ｍＡの消費電流Ｉｍが流れる。この場合の投光素子（3）に流れる投光電流Ｉｈのピーク値は、デューティ比５％として約１００ｍＡであり、この投光電流Ｉｈに比例した強度で投光素子（3）が発光する。直流電源回路（1'）は、光電スイッチ全体の消費電流である１５ｍＡの電流Ｉａを投光回路（2'）と受光回路（4'）に分流させて供給する。

【０００７】

【発明が解決しようとする課題】上記構造の小形軽量の光電スイッチは、投光電流Ｉｈをできるだけ大きくして、検出できる物品との間の設定距離を延ばすように設計されているが、後述理由で投光電流Ｉｈは既に上限に達しており、設定距離の増大化が難しいのが現状である。

【０００８】例えば図３の光電スイッチの全体の消費電力は、直流電源電圧Ｖａが３０Ｖ、投光回路（2'）の消費電流Ｉｍが５ｍＡ、受光回路（4'）の消費電流Ｉｎが１０ｍＡとして３０Ｖ×（１０＋５）ｍＡ＝４５０ｍＷである。この内、直流電源回路（1'）の消費電力は、（３０－８）Ｖ×１５ｍＡ＝３３０ｍＷと最も多く、この消費電力に応じた量で直流電源回路（1'）が最も発熱する。この発熱は、小型化のため直流電源回路（1'）に回路素子が少ないドロップ電源（シリーズ電源）を使用する以上やむを得ないところである。また、直流電源回路（1'）と投光回路（2'）、受光回路（4'）の各々は、直流電源回路（1'）の発熱で回路素子が損傷を受けない程度の密度でコンパクト実装され、光電スイッチの小形軽量化が図られている。

【０００９】かかる光電スイッチにおいて、投光電流Ｉｈを増大させることは回路的に可能であるが、投光電流Ｉｈの増大分に比例して光電スイッチの消費電力が増し、特に直流電源回路（1'）の発熱量が増大して、ＩＣなどの回路素子が熱で破壊される恐れが増す。投光電流Ｉｈの増大による発熱の問題は、各回路の実装密度を小さくしたり、放熱手段を付け加えることで解決できるが、このようにすると光電スイッチが大形化し、コスト高となる不具合が生じる。また、投光電流Ｉｈを増大させた分、直流電源回路（1'）に電源容量の大きなものが必要となって、光電スイッチが尚更にコスト高、大形化する。

【００１０】本発明の目的とするところは、小形軽量のまま投光電流が増大できる光電スイッチを提供することにある。

【００１１】

【課題を解決するための手段】上記目的を達成する本発明の技術的手段は、定電圧の電力を供給する直流電源回路に、この直流電源回路からの電流で投光素子を発光さ

せる投光回路と、投光回路の投光素子からの光を受光する受光素子を備えた受光回路とを直列接続したことである。

【００１２】このような光電スイッチにおいては、受光回路に定電圧回路を並列接続しておくことが、受光回路の動作安定化の上で望ましい。

【００１３】

【作用】直流電源回路に投光回路と受光回路を直列接続すると、ドロップ電源である直流電源回路における電圧降下（電力消費量）が低下し、この電力分を投光回路に供給できて、投光回路の投光電流が増大し、光電スイッチから物品までの設定距離が延ばせる。また、直流電源回路の発熱量が小さくなり、その容量を従来よりも小さ目にできるから、光電スイッチの小形軽量を維持できる。

【００１４】また、受光回路に定電圧回路を並列接続しておくと、投光回路の影響を受けること無く受光回路の入力電圧が一定となって、増幅回路などのある受光回路の動作が安定し、光電スイッチの特性が安定する。

【００１５】

【実施例】以下、実施例について図１、図２を参照して説明する。図１に示される光電スイッチは、１つのハウジング（7）に直流電源回路（1）と投光回路（2）と受光回路（4）を内蔵した反射型光電スイッチで、直流電源回路（1）に投光回路（2）と受光回路（4）を直列に接続したことを特徴とする。直流電源回路（1）は、入力端子（8）からの直流電源電圧Ｖａを定電圧Ｖｂに降圧した電流Ｉａを投光回路（2）と受光回路（4）に流す。受光回路（4）には投光回路（2）で降圧された定電圧Ｖｃが印加され、この定電圧Ｖｃを一定に安定化させる目的で受光回路（4）に定電圧回路（6）が並列接続される。

【００１６】図１の光電スイッチの直流電源回路（1）と投光回路（2）、受光回路（4）の各々は、大部分がＩＣ化された部品点数の少ない、低電圧低電流駆動する低消費電力、低発熱タイプの回路で、基本的には図３の光電スイッチのものと同一であり、図１と図３の共通部分には同一符号が付してある。図１の光電スイッチが図３の光電スイッチと同一の消費電力タイプであるとして、図１の光電スイッチを説明する。

【００１７】直流電源回路（1）は、入力端子（8）の例えば３０Ｖの直流電源電圧Ｖａを８Ｖの定電圧Ｖｂに降圧し、１５ｍＡの電流Ｉａを投光回路（2）に供給する。直流電源回路（1）は、例えば図２に示されるようなドロップ電源回路で、逆流防止用の保護ダイオード（11）、定電圧素子であるツェナーダイオード（12）と抵抗（13）、平滑コンデンサ（14）などを備える。直流電源回路（1）の８Ｖの定電圧Ｖｂが投光回路（2）と受光回路（4）の直列回路に印加され、投光回路（2）と受光回路（4）の各々には８Ｖの定電圧Ｖｂを分圧した例えば４Ｖの直流電圧が印加される。この場合、投光回路（2）と受光回路（4）の各々は、定格電圧４Ｖで動作するよう回路設計され、この点が図３の投光回路（2'）と受光回路（4'）と異なる。

【００１８】直流電源回路（1）からの１５ｍＡの電流Ｉａがそのまま投光回路（2）に消費電流Ｉｂとして流れる。投光回路（2）は、例えば図２に示すように、発振回路（15）と発光素子（3）のドライブ回路（16）で構成される。投光回路（2）の１５ｍＡの消費電流Ｉｂは、図３光電スイッチの投光回路（2'）の５ｍＡの消費電流Ｉｎの３倍である。したがって、投光素子（3）に流れる投光電流Ｉｃのピーク値は、デューティ比５％として約３００ｍＡとなり、図３光電スイッチの投光電流Ｉｈの約３倍となる。この投光電流Ｉｃの増加分だけ、投光素子（3）の光の強度が増し、光電スイッチで検出できる物品までの設定距離が延びる。実際、投光電流Ｉｃの従来比３倍の増加で、設定距離が従来比で１．７倍になることが分かっている

【００１９】受光回路（4）に並列接続された定電圧回路（6）は、例えばツェナーダイオード（23）と平滑コンデンサ（24）の並列回路で、受光回路（4）の入力電圧を４Ｖに安定化させる。受光回路（4）と定電圧回路（6）の並列回路に、投光回路（2）から１５ｍＡの電流が流れる。受光回路（4）の消費電流Ｉｄを図３の受光回路（4'）と同一の１０ｍＡとすると、定電圧回路（6）に５ｍＡの消費電流Ｉｅが流れる。

【００２０】受光回路（4）は、例えば図２に示すように、受光素子（5）の受光信号を増幅する増幅回路（17）、増幅された信号を基準レベルと比較して物品有無の判定をするコンパレータ（18）、同期用の発振回路（19）、検波回路（20）と出力回路（21）を備える。この受光回路（4）に印加される投光回路（2）で降圧された４Ｖの電圧Ｖｃが不安定であると、増幅回路（17）などの動作が不安定となって、物品有無検出の信頼性が悪くなる。そこで、この動作不安定を解消するために、受光回路（4）に定電圧回路（6）が並列接続される。定電圧回路（6）は、ツェナーダイオード（23）の４Ｖのツェナー電圧でもって、受光回路（4）の入力電圧を４Ｖに一定化して、受光回路（4）の動作を安定なものにする。

【００２１】図１の光電スイッチの消費電力は、３０Ｖ×（１０＋５）ｍＡ＝４５０ｍＷで、図３の光電スイッチの消費電力と同一である。つまり、図１光電スイッチは、図３光電スイッチと発熱量が同一で、図３光電スイッチとほぼ同一サイズに小形軽量化される。

【００２２】図１の光電スイッチの投光回路（2）に流す電流値は１５ｍＡに限らず、仮に１０ｍＡの電流を流すようにすると、投光電流は図３の光電スイッチの投光電流の約２倍となり、物品との設定距離が延びる。この場合、図１の光電スイッチの消費電力が図３の光電スイ

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ッチの消費電力４５０mWより１５０mW少なくなり、その分、図１の光電スイッチの発熱量が少なくなって、より小形化が図れる。

【００２３】

【発明の効果】本発明によれば、直流電源回路からの直流電流が分流されることなくそのまま投光回路に流れるので、直流電源回路の消費電力を増加させること無く投光回路の投光電流の増大化が容易となり、物品までの設定距離の延長化が可能な高性能の小形軽量光電スイッチが提供できる。

【００２４】また、受光回路に定電圧回路を並列接続しておくことにより、投光回路の影響を受けること無く受光回路の入力電圧が一定となって、受光回路の動作が安定し、動作特性の安定した高信頼度の光電スイッチが提

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供できる。

【図面の簡単な説明】

【図１】本発明に係る光電スイッチの一実施例を示すブロック図。

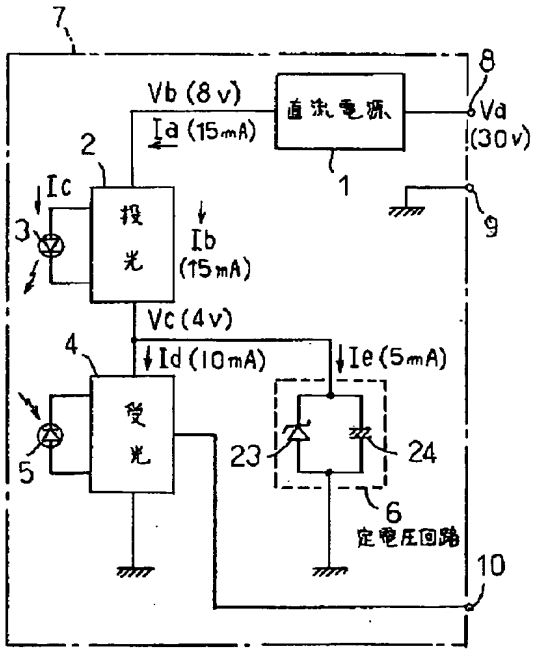
【図２】図１の光電スイッチの回路例を示す回路図。

【図３】従来の光電スイッチのブロック図。

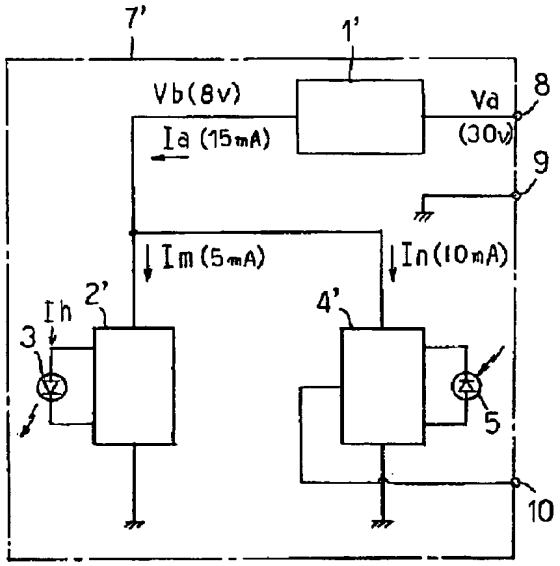
【符号の説明】

1　直流電源回路
2　投光回路
3　投光素子
4　受光回路
5　受光素子
6　定電圧回路

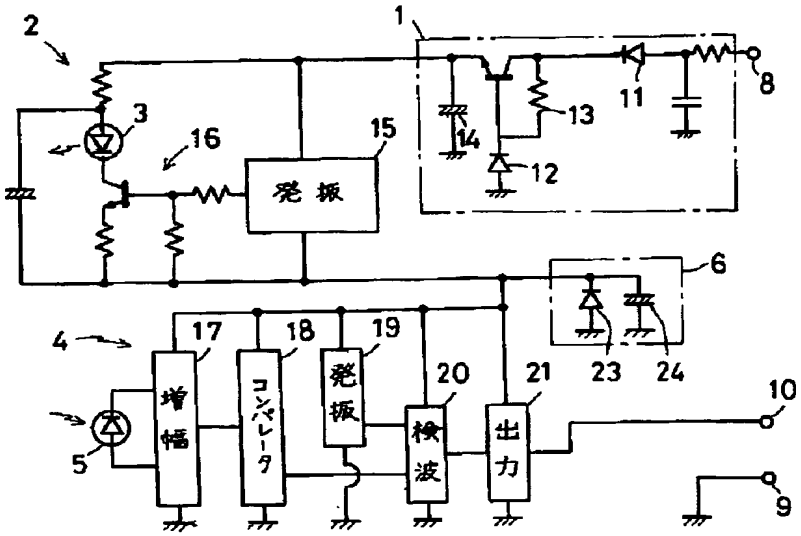
【図１】



【図３】



【図２】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増幅
コンパレータ
発振
検波
出力